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(54) TRAY FOR MICROWAVE COOKING

Schale zum Microwellenkochen

BAC DE CUISSON POUR FOUR A MICRO-ONDES

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Description

The present invention relates to microwave cooking of foodstuffs.

The use of microwave energy to cook a variety of prepared foodstuffs for consumption is increasing. One of the problems associated with such cooking is to achieve an even distribution of heat in the cooked product, particularly in frozen products. For example, foodstuffs like macaroni and cheese and lasagna, which are cooked in trays, tend to be hotter in the peripheral regions of the tray than in the central regions when cooked by exposure to microwave energy.

The trays in which the foodstuffs are cooked generally are formed of rigid polymeric materials or polymeric material-coated paperboard.

It has previously been proposed in U.S. Patent No. 4,351,997 to provide a modified form of tray structure to attempt to provide a more even heating of foodstuff in the tray when exposed to microwave radiation. This prior art tray has a bottom wall of microwave-transparent material and an upwardly-extending peripheral wall which is outwardly curved at its upper end to define a horizontally-extending peripheral rim.

The rim is partly or completely coated with a material which is reflective and opaque to microwave radiation, such as aluminum foil. The peripheral wall also is partly or completely coated with the foil material. The effect of this aluminum foil coating on the wall is to provide reflection of microwave energy towards the centre of the tray.

In this structure, therefore, both the outer surface of the rim and the walls are coated, at least partially with aluminum foil. The arrangement as described in this prior art provides aluminum metal directly in contact with the food in the tray, which is unsatisfactory in many foodstuff applications, because of the possibility of contamination of the foodstuff. The coating on the rim is said to protect the paperboard rim from being deteriorated in use of the tray.

US Patent No. 4,626,641 describes an embodiment in which a similar structure is provided. In addition to the provision of aluminum foil in the side wall of a tray, the foil also extends into the base of the container but leaves a rectangular open area in the bottom wall.

In DE-A-3,242,402 (equivalent to GB-A-2,112,257) there is disclosed a tray for the microwave cooking of a prepared foodstuff contained therein, comprising a bottom wall and an upwardly extending peripheral wall, said tray having a laminate structure comprising an outer layer of a structural material transparent to microwave energy, an inner layer of a flexible polymeric material coincident with said outer layer, and a layer of microwave-reflective material located between said inner layer and said outer layer as a continuous layer in the region of said peripheral wall.

While these prior art structures provide an improved uniformity of heating of the foodstuff in a microwave oven, there remains a significant spread of temperature between the edge regions and core regions of the foodstuff.

In accordance with the present invention there is provided an improved tray structure for the microwave cooking of a foodstuff packaged therein, which is able to obtain a much improved uniformity of heating of the foodstuff.

In accordance with the present invention there is provided a tray for the microwave cooking of a prepared foodstuff contained therein, comprising: a bottom wall and an upwardly extending peripheral wall, said tray having a laminate structure comprising an outer layer of a structural material transparent to microwave energy, an inner layer of a flexible polymeric material coincident with said outer layer, and a layer of microwave-reflective material located between said inner layer and said outer layer as a continuous layer in the region of said peripheral wall, and extending in a microwave energy controlling pattern along said bottom wall, said pattern being arranged to provide a controlled degree of penetration of incident microwave energy through said bottom wall to channel microwave energy preferentially towards a central region of said tray, which, combined with reflection from the microwave-reflective material in the peripheral wall, results in an improved uniformity of microwave cooking of the prepared foodstuff in the tray, characterised in that said pattern is formed in the peripheral region of the bottom wall of the tray to leave an area in the central region of the bottom wall from which the microwave-reflective material is absent, the pattern being formed by strips of the microwave-reflective material which are spaced from each other and arranged around the said area from which the microwave-reflective material is absent.

The structure of the present invention exhibits several distinctions over the art, in particular, U.S. Patents Nos. 4,351,997 and 4,626,641. One distinction is that the aluminum foil layer in the present invention is completely protected from engagement with the foodstuff by the polymeric film layer, thereby eliminating the potential for food contamination by the metal. Another distinction is that it is unnecessary to provide metal in the area of any rim of the tray. In this regard, it has not been found necessary for the rim to be protected in the microwave environment.

In addition, and most importantly, the aluminum foil extends not only completely around the peripheral wall of the tray but also for a significant distance along the bottom wall towards the centre in the form of a pattern. In contrast to U.S. Patent 4,626,641, the metal is provided in the bottom wall, not as a continuous layer as in the prior art but as a patterned layer which permits a controlled degree of penetration of microwave energy. By providing the microwave-reflective layer extending not only continuously in the whole of the peripheral wall but also in patterned form in a portion of the bottom wall, the microwave energy is drawn or channelled more towards the centre of the tray, which, combined with reflection from the microwave-reflective material in the

peripheral wall, leads to a more uniform heating of foodstuffs, particularly frozen foodstuffs, in the tray than has heretofore been obtained.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings:-

Figure 1 is a perspective view of a microwave-heating tray provided in accordance with one embodiment of the invention; and

Figure 2 is a longitudinal sectional view of the microwave-heating tray of Figure 1.

As noted earlier, the present invention is concerned with a novel tray structure useful for the microwave heating of foodstuffs for consumption. The tray may be produced in any convenient manner from the laminate, such as by press moulding or folding.

The laminate from which the trays of the present invention are formed comprises an outer continuous structural supporting substrate layer, an outer continuous flexible polymeric film layer and a discontinuous layer of microwave-reflective material located between the outer layers.

The structural substrate of microwave-transparent dielectric material may be constructed of any convenient material, such as paperboard of suitable thickness or a polymeric material, such as a polyester or a polyolefin.

The laminate structure may be formed in any convenient manner. In one preferred embodiment, the microwave-reflective material is aluminum of a thickness of about 1 to about 15 microns, preferably about 3 to about 10 microns, typically about 7 to 8 microns.

The aluminum foil may be provided as a vapor-deposited film on the polymeric film layer or, more usually, adhered thereto by laminating adhesive. The polymeric film may be provided by any convenient flexible polymeric material which will resist thermal degradation during lamination and microwave cooking. Suitable polymeric materials include polyesters, such as "Mylar", or polyolefins, such as polyethylene.

Selective demetallization of aluminum from the portions of the surface of the aluminum layer may be effected to leave aluminum in the areas desired in the tray. Selective demetallization may be effected using an aqueous etchant, such as aqueous sodium hydroxide solution, using the procedures described in U.S. Patents Nos. 4,398,994 and 4,552,614, the disclosures of which are incorporated herein by reference.

Following such selective demetallization of the aluminum foil layer, the polymeric film bearing the remaining aluminum is laminated to the supporting substrate layer to provide the laminate from which the tray is formed. Alternatively, but less conveniently, the supporting substrate layer may first be shaped and then the aluminized polymeric film is laminated to the supporting substrate layer.

As noted above, one of the significant structural features of the present invention is that the microwave-reflective layer extends for a significant distance along the bottom wall of the tray in the form of a microwave-energy controlling pattern.

The desired pattern is formed in the peripheral region of the bottom wall of the tray and leaves an area in the central region of the bottom wall from which the microwave-reflective material is absent. The pattern is intended to slow down or moderate penetration of microwave energy in the peripheral regions of the foodstuff, and direct more energy towards the centre of the foodstuff.

In this regard, if the bottom of the tray is left completely open, with no microwave-reflective material at all present, then the foodstuff is adequately cooked in the peripheral regions of the tray but is insufficiently cooked in the centre or core. Similarly, if the bottom of the tray is provided with a continuous layer of microwave-reflective material extending inwardly from the edges to a central aperture in such material, then, while the central region of the foodstuff is adequately cooked, the peripheral regions of the tray are insufficiently cooked.

However, by providing a pattern of microwave-reflective material in the base of the tray, the microwave energy distribution to which the foodstuff is exposed can be controlled to provide a more uniformly-cooked product than has hitherto been possible.

The pattern may take various forms depending on the shape and size of the tray and the foodstuff to be heated therein, but generally the microwave-reflective material maintains a continuous layer with the side wall layer. The pattern may take the form of strips of metal arranged in a series of rectangles, circles or squares, depending on the shape of the tray and the effects desired.

The open area of the bottom wall not having the patterned metal layer is generally shaped with the same shape as the bottom wall. Thus, if the tray is of a generally rectangular shape, the inner periphery of the metal layer also is of rectangular shape.

The proportion of the area of the bottom wall of the tray in which the pattern metal layer is provided and the proportion of metal to open area in the patterned region depend on the degree of channelling and control of penetration required for the specific foodstuff being microwave-heated in the tray.

Referring to the drawings, a tray 10 constructed in accordance with one embodiment of the invention, is of one-pieced shaped construction formed from a laminate. The tray 10 has a bottom wall 12, a peripheral wall 14 extending upwardly and outwardly from the bottom wall and terminating in an upper outwardly-extending rim 16.

The form of the laminate at various locations in the tray structure is shown in Figures 1 and 2. An outer layer 18 of structural material supports the laminate. An inner polymeric film layer 20 is coincident with the outer layer 18 throughout the structure.

A layer of microwave-reflective material 22 is pro-

vided between the outer and inner layers 18 and 20 in the region of the peripheral wall 14 and extending in a pattern 23 (Figure 1) for a portion of the area of the bottom wall 12.

The microwave-reflective material is absent from the laminate in the area of the bottom wall defined by a rectangular periphery 24 of the pattern 23 of microwave-reflective material.

Although the tray is illustrated as having a rectangular shape, the tray may be provided in a variety of other geometric shapes, such as square or circular.

Example

This Example illustrates the beneficial effect obtained using the structure of the present invention.

Macaroni and cheese was placed in a dish constructed as seen in Figure 1 and in a dish having an aperture only in the bottom wall, such as is described in U.S. Patent No. 4,351,997. Both samples were exposed to microwave energy in a microwave oven for 5 minutes and the temperature at three locations midway in the depth of the cooked product was determined, namely core, outer edge and an intermediate location. The results obtained are set forth in the following Table I:

Table I

Structure	Temperature °F			
	Core	Middle	Edge	Range
Figure 1	131°	160°	173°	42°
Prior art	118°	168°	171°	53°
Difference				11°F

It will be seen from the results of above Table I that by employing the structure of the present invention, the core temperature is significantly increased, the spread in temperature between edge and core is significantly decreased, by about 20%, and the uniformity of temperature from the edge to the core is improved.

In summary of this disclosure, the present invention provides a novel tray structure useful for the microwave cooking of prepared foodstuffs for consumption by incorporating a layer of microwave-reflective material into the structure. Modifications are possible within the scope of the claims.

Claims

1. A tray for the microwave cooking of a prepared foodstuff contained therein, comprising:

   a bottom wall (12) and an upwardly extending peripheral wall (14),

   said tray (10) having a laminate structure comprising an outer layer (18) of a structural material transparent to microwave energy, an inner layer (20) of a flexible polymeric material coincident with said outer layer, and a layer (22) of microwave-reflective material located between said inner layer (20) and said outer layer (18) as a continuous layer in the region of said peripheral wall (14), and extending in a microwave energy controlling pattern (23) along said bottom wall (12),

   said pattern being arranged to provide a controlled degree of penetration of incident microwave energy through said bottom wall (12) to channel microwave energy preferentially towards a central region of said tray (10), which, combined with reflection from the microwave-reflective material in the peripheral wall, results in an improved uniformity of microwave cooking of the prepared foodstuff in the tray,

   characterised in that

   said pattern is formed in the peripheral region of the bottom wall of the tray to leave an area in the central region of the bottom wall from which the microwave-reflective material is absent, the pattern being formed by strips of the microwave-reflective material which are spaced from each other and arranged around the said area from which the microwave-reflective material is absent.

2. A tray according to claim 1 wherein the said area from which the microwave-reflective material is absent is generally shaped with the same shape as the bottom wall.

3. A tray according to claim 1 or 2 wherein the pattern takes the form of strips of microwave-reflective material arranged in a series of geometric shapes depending on the shape of the tray.

4. A tray according to claim 1, 2, or 3 wherein the pattern takes the form of strips arranged in a series of rectangles.

5. A tray according to claim 1, 2, or 3 wherein the pattern takes the form of strips arranged in a series of circles.

6. A tray according to claim 1, 2, or 3 wherein the pattern takes the form of strips arranged in a series of squares.

7. A tray according to any preceding claim wherein said pattern (23) is formed by an endless strip of said microwave-reflective material formed in said bottom wall.

8. A tray according to any preceding claim wherein said pattern (23) is such that the microwave-reflective material in the bottom wall maintains a continuous layer with the side wall layer of microwave-reflective material.

9. A tray according to any preceding claim wherein a rim (16) extends outwardly from said peripheral wall (14) at the top thereof.

10. A tray according to any preceding claim wherein said microwave-reflective material (22) is aluminium having a thickness of 1 to 15 microns.

11. A tray according to claim 10 wherein said aluminium (22) has a thickness of 3 to 10 microns.

12. A tray according to claim 10 wherein said aluminium (22) has a thickness of 7 to 8 microns.

13. A tray according to any preceding claim wherein said outer layer (18) is constructed of paperboard.

14. A tray according to any of claims 1 to 12 wherein said outer layer (18) is constructed of polymeric material.

Patentansprüche

1. Schale zum Kochen eines darin enthaltenen vorbereiteten Nahrungsmittels mit Mikrowellen, welche aufweist:

   eine Bodenwand (12) und eine sich nach oben erstreckende Umfangswand (14),
   wobei die Schale (10) aufweist: eine Laminatstruktur mit einer äußeren Schicht (18) aus einem Strukturmaterial, welches durchlässig für Mikrowellenenergie ist, eine innere Schicht (20) aus einem flexiblen Polymermaterial, die sich mit der äußeren Schicht deckt, und eine Schicht (22) aus Mikrowellen reflektierendem Material, die zwischen der inneren Schicht (20) und der äußeren Schicht (18) als kontinuierliche Schicht in dem Bereich der Umfangswand (14) angeordnet ist und sich in einem die Mikrowellenenergie kontrollierenden Muster (23) entlang der Bodenwand (12) erstreckt, wobei das Muster so angeordnet ist, daß es ein kontrolliertes Maß an Penetration von auftreffender Mikrowellenenergie durch die Bodenwand (12) bereitstellt, um Mikrowellenenergie vorzugsweise in Richtung eines Mittelbereichs der Schale (10) zu lenken, was in Kombination mit der Reflexion von dem Mikrowellen reflektierenden Material in der Umfangswand eine verbesserte Gleichmäßigkeit des Mikrowellenkochens des vorbereiteten Nahrungsmittels in der Schale zur Folge hat, dadurch gekennzeichnet, daß das Muster in dem Randbereich der Bodenwand der Schale so gebildet ist, daß eine Fläche in dem Mittelbereich der Bodenwand verbleibt, welche kein Mikrowellen reflektierendes Material aufweist, wobei das Muster durch Streifen aus dem Mikrowellen reflektierenden Material gebildet ist, die voneinander beabstandet sind und um die Fläche herum angeordnet sind, welche kein Mikrowellen reflektierendes Material aufweist.

2. Schale nach Anspruch 1, wobei die Fläche, welche kein Mikrowellen reflektierendes Material aufweist, im allgemeinen gleich geformt ist wie die Bodenwand.

3. Schale nach Anspruch 1 oder 2, wobei das Muster die Form von Streifen aus Mikrowellen reflektierendem Material annimmt, die in Abhängigkeit von der Form der Schale in einer Reihe von geometrischen Formen angeordnet sind.

4. Schale nach Anspruch 1, 2 oder 3, wobei das Muster die Form von Streifen annimmt, die in einer Reihe von Rechtecken angeordnet sind.

5. Schale nach Anspruch 1, 2 oder 3, wobei das Muster die Form von Streifen annimmt, die in einer Reihe von Kreisen angeordnet sind.

6. Schale nach Anspruch 1, 2 oder 3, wobei das Muster die Form von Streifen annimmt, die in einer Reihe von Quadraten angeordnet sind.

7. Schale nach einem der vorhergehenden Ansprüche, wobei das Muster (23) aus einem endlosen Streifen aus dem Mikrowellen reflektierendem Material gebildet ist, der in der Bodenwand gebildet ist.

8. Schale nach einem der vorhergehenden Ansprüche, wobei das Muster (23) dergestalt ist, daß das Mikrowellen reflektierende Material in der Bodenwand weiterhin mit der Seitenwandschicht aus Mikrowellen reflektierendem Material eine kontinuierliche Schicht formt.

9. Schale nach einem der vorhergehenden Ansprüche, wobei sich von der Umfangswand (14) an deren oberen Seite ein Rand (16) nach außen erstreckt.

10. Schale nach einem der vorhergehenden Ansprüche, wobei das Mikrowellen reflektierende Material (22) Aluminium mit einer Dicke von 1 bis 15 Mikrometern ist.

11. Schale nach Anspruch 10, wobei das Aluminium (22) eine Dicke von 3 bis 10 Mikrometern hat.

12. Schale nach Anspruch 10, wobei das Aluminium (22) eine Dicke von 7 bis 8 Mikrometern hat.

13. Schale nach einem der vorhergehenden Ansprüche, wobei die äußere Schicht (18) aus Pappe gebildet ist.

14. Schale nach einem der Ansprüche 1 bis 12, wobei die äußere Schicht (18) aus Polymermaterial gebildet ist.

Revendications

1. Barquette pour la cuisson par micro-ondes d'un aliment préparé qui y est contenu, comprenant:

une paroi de fond (12) et une paroi périphérique (14) qui s'étend vers le haut,
ladite barquette (10) ayant une structure stratifiée comprenant une couche extérieure (18) en une matière structurale transparente vis à vis de l'énergie hyperfréquence, une couche intérieure (20) coïncidant avec ladite couche extérieure, en une matière polymère flexible, et une couche (22) en une matière réfléchissant les micro-ondes, disposée entre ladite couche intérieure (20) et ladite couche extérieure (18) sous forme de couche continue dans la région de ladite paroi périphérique (14) et se prolongeant par une partie structurée (23) de commande de l'énergie hyperfréquence le long de ladite paroi de fond (12), ladite partie structurée étant agencée de manière à établir un degré commandé de pénétration de l'énergie hyperfréquence incidente à travers ladite paroi de fond (12) pour canaliser préférentiellement l'énergie hyperfréquence vers une région centrale de ladite barquette (10), ce qui conduit, en combinaison avec la réflexion sur la matière réfléchissant les micro-ondes dans la paroi périphérique, à une plus grande uniformité de cuisson par micro-ondes de l'aliment préparé contenu dans la barquette,

caractérisée en ce que ladite partie structurée est formée dans la région périphérique de la paroi de fond de la barquette de manière à laisser, dans la région centrale de la paroi de fond, une zone dépourvue de la matière réfléchissant les micro-ondes, la partie structurée étant formée de bandes de la matière réfléchissant les micro-ondes qui sont espacées les unes des autres et disposées autour de ladite zone dépourvue de la matière réfléchissant les micro-ondes.

2. Barquette selon la revendication 1, dans laquelle ladite zone dépourvue de la matière réfléchissant les micro-ondes a généralement la même forme que la paroi de fond.

3. Barquette selon la revendication 1 ou 2, dans laquelle la partie structurée prend la forme de bandes de matière réfléchissant les micro-ondes, disposées en une série de figures géométriques dont la forme dépend de celle de la barquette.

4. Barquette selon l'une quelconque des revendications 1 à 3, dans laquelle la partie structurée prend la forme de bandes disposées en une série de rectangles.

5. Barquette selon l'une quelconque des revendications 1 à 3, dans laquelle la partie structurée prend la forme de bandes disposées en une série de cercles.

6. Barquette selon l'une quelconque des revendications 1 à 3, dans laquelle la partie structurée prend la forme de bandes disposées en une série de carrés.

7. Barquette selon l'une quelconque des revendications 1 à 6, dans laquelle ladite partie structurée (23) est constituée par une bande sans fin de ladite matière réfléchissant les micro-ondes, formée dans ladite paroi de fond.

8. Barquette selon l'une quelconque des revendications 1 à 7, dans laquelle ladite partie structurée (23) est telle que la matière réfléchissant les micro-ondes dans la paroi de fond forme une couche continue avec la couche de matière réfléchissant les micro-ondes dans la paroi latérale.

9. Barquette selon l'une quelconque des revendications 1 à 8, dans laquelle un rebord (16) s'étend vers l'extérieur à partir de ladite paroi périphérique (14) au sommet de celle-ci.

10. Barquette selon l'une quelconque des revendications 1 à 9, dans laquelle ladite couche (22) en une matière réfléchissant les micro-ondes est une feuille d'aluminium ayant une épaisseur de 1 à 15 µm.

11. Barquette selon la revendication 10, dans laquelle ladite feuille d'aluminium (22) a une épaisseur de 3 à 10 µm.

12. Barquette selon la revendication 10, dans laquelle ladite feuille d'aluminium (22) a une épaisseur de 7 à 8 µm.

13. Barquette selon l'une quelconque des revendications 1 à 12, dans laquelle ladite couche extérieure (18) est faite de carton.

14. Barquette selon l'une quelconque des revendications 1 à 12, dans laquelle ladite couche extérieure

(18) est faite de matière polymère.

FIG.1.

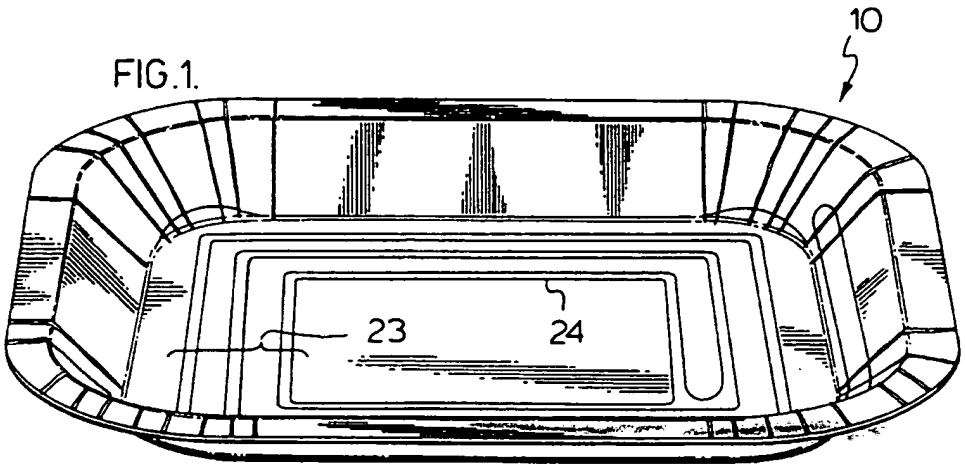

FIG.2.